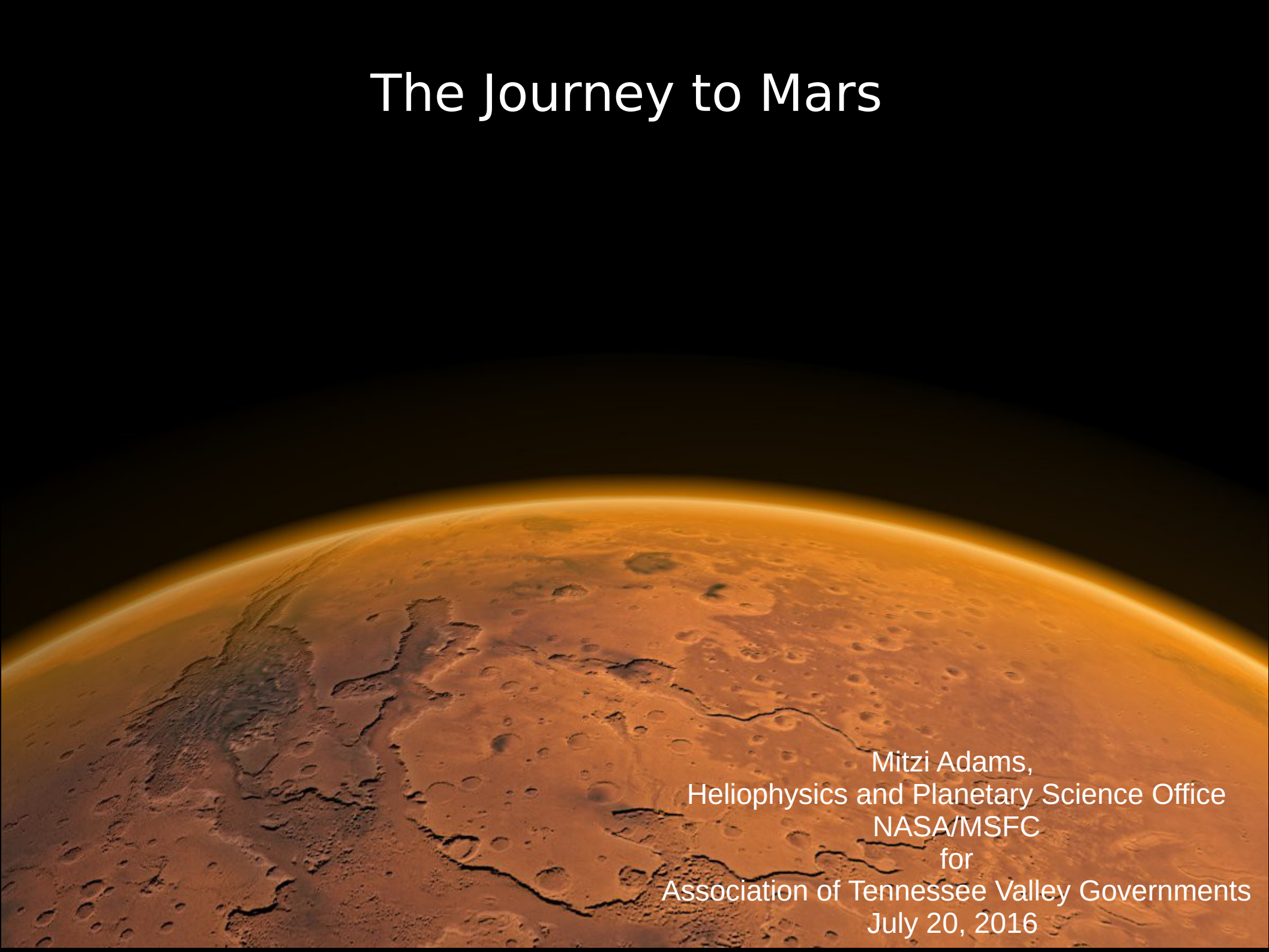
The Journey to Mars

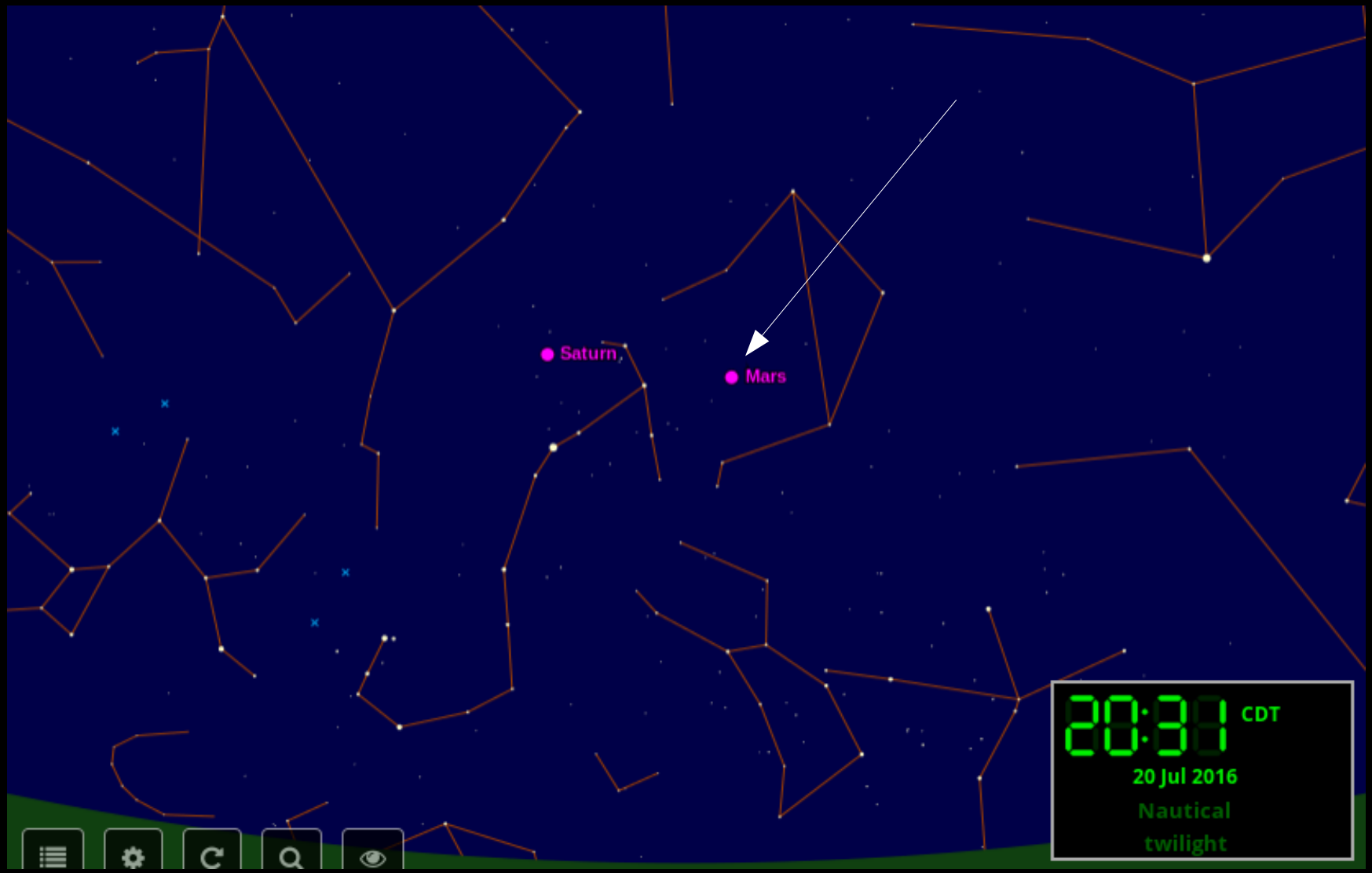


Mitzi Adams,
Heliophysics and Planetary Science Office
NASA/MSFC
for
Association of Tennessee Valley Governments
July 20, 2016

Why Mars?

Mars, the Fourth Rock from the Sun

Mars, one of the original seven *planetes* of the solar system: Sun, Mercury, Venus, Moon, Mars, Jupiter, Saturn.



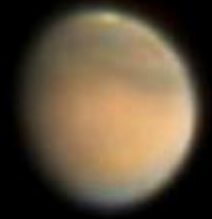
Mars, the Fourth Rock in the Age of the Telescope

Galileo observed Mars in 1610 with a telescope (20x).

Christiaan Huygens: 1659, 50x telescope:
"The rotation of Mars, like that of Earth, seems to have a period of 24 hours."

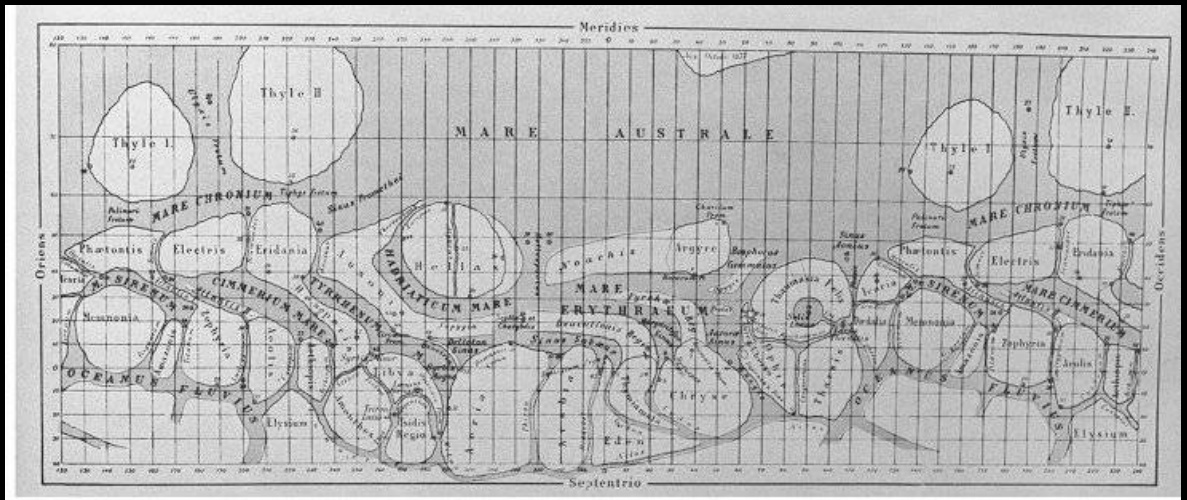
Giovanni Domenico Cassini worked out the distance to Mars in 1672.

The planet Mars. Observed September 3, 1877, at 11h. 55m. p.m. (Plate VIII from The Trouvelot Astronomical Drawings 1881-1882). The drawing features are described in the following work: Trouvelot, Étienne Léopold (1882), The Trouvelot astronomical drawings manual, New York: Charles Scribner's sons, p. 64.



1877: Giovanni Virginio Schiaparelli, inspired as a child by a total solar eclipse to study astronomy, began his systematic mapping of Mars.

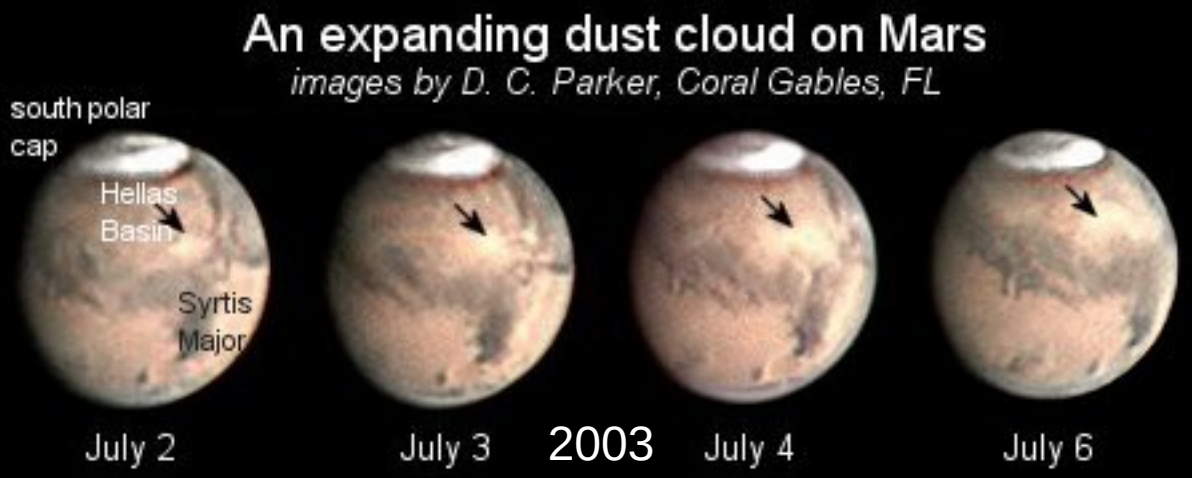
canali: channels or canals, or *fume*: rivers



Schiaparelli's 1877 map

H.G. Wells born
in 1866
War of the Worlds
published in 1898

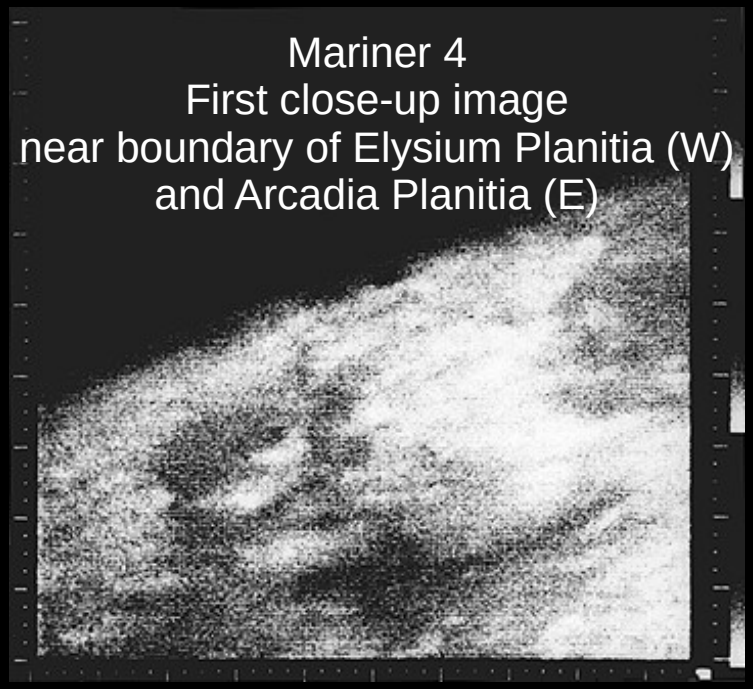
Modern (during Space Age) Mars Observations

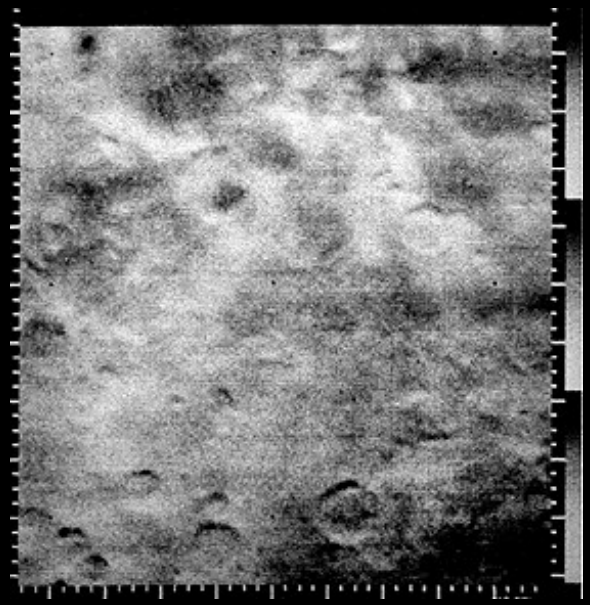


Mars Facts

Atmosphere:	Mostly carbon dioxide, some water vapor
Surface Pressure:	0.01 bars (Venus is 92 bars)
Temperature:	Average -63 deg C (-81 deg F)
Day:	24 hours 37 minutes
Year:	687 Earth days
Axial Tilt:	25 deg
Diameter:	6791 km (4220 miles)
Distance from Sun:	229 million km (142 million miles)
Moons:	2, Phobos and Deimos
Gravity:	0.375 Earth

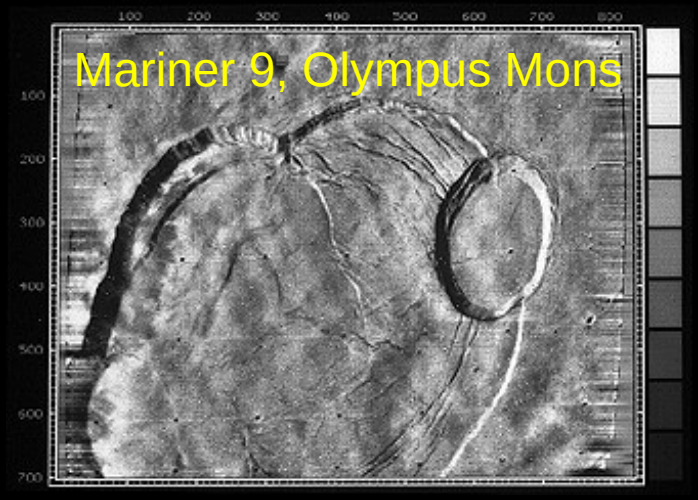
Observing Mars in the Modern Era



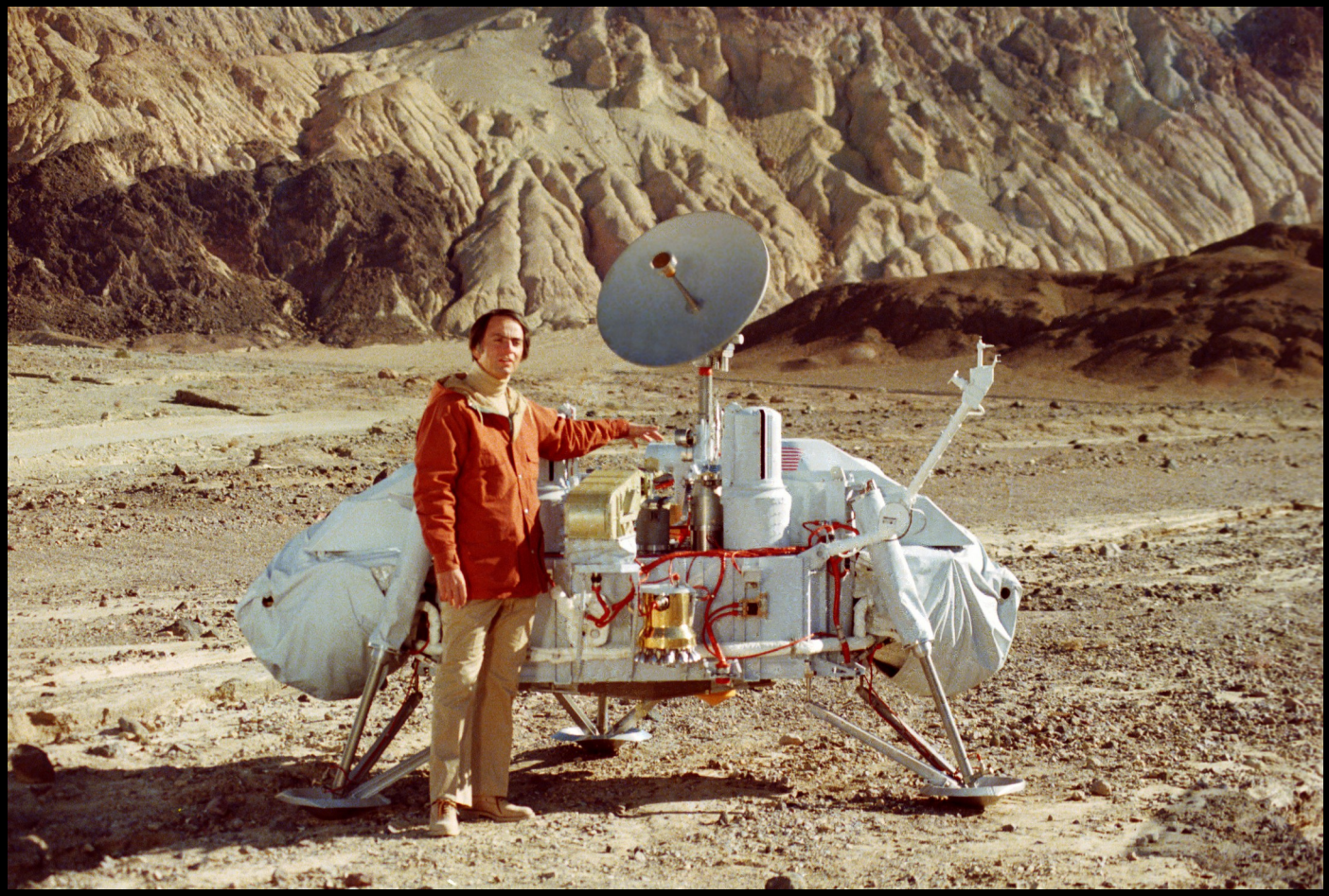


Also Mariner 4, south of Amazonis Planitia

1965: Mariner 4 flew by Mars -- Lots of craters, no canals
1969: Mariners 6 and 7, confirmed no canals
1971: Mariner 9, placed into orbit
1976: Viking landed on the surface of Mars



Viking 1 Landed on Mars July 20, 1976 -- uncaging mechanism did not work...no seismic data



Viking 2 landed September 3, 1976 -- bad ground coupling, recorded only wind events

Mars Global Surveyor

- Launched November 7, 1996
- Arrived September 12, 1997

First spacecraft to image and map the planet, finding water erosion, a meter-thick layer of dust on Phobos, and diminishing amounts of CO_2 at the south polar cap.

MGS failed in 2007, four-times longer than initial mission -- from battery failure.

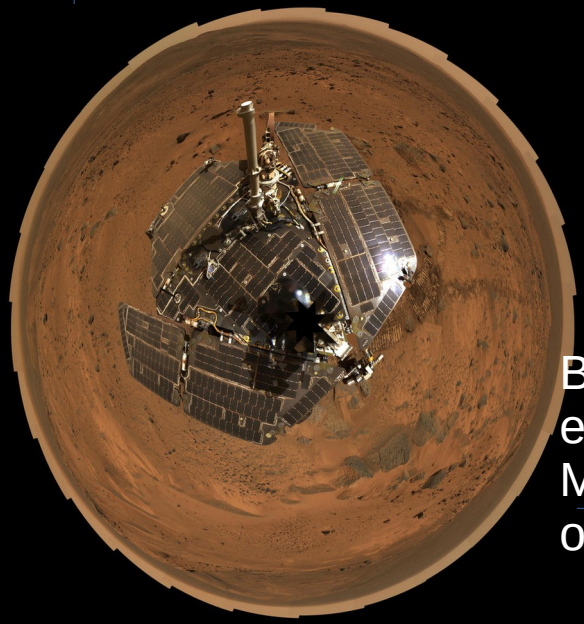
Mars Exploration Rovers

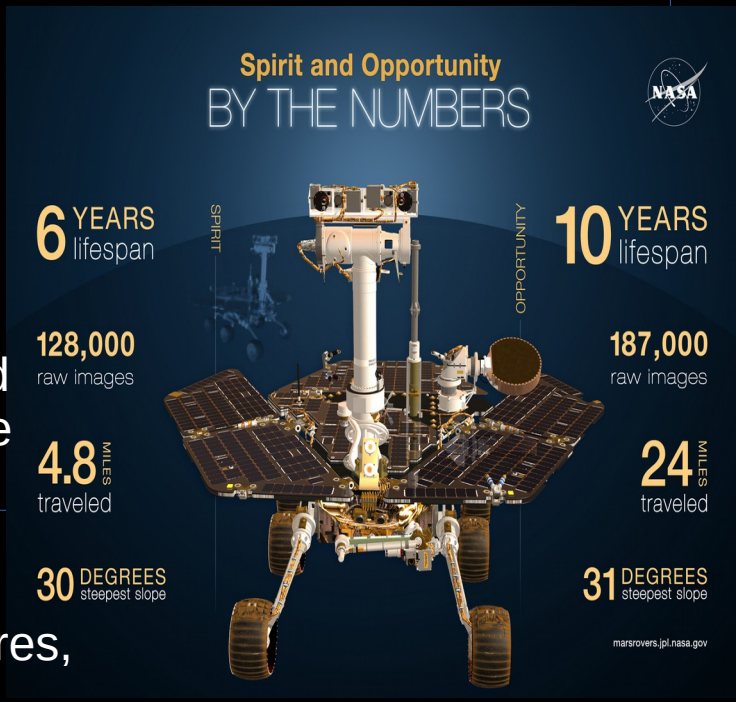
Spirit

- Launched June 10, 2003
- Arrived January 3, 2004

Opportunity

- Launched July 7, 2003
- Arrived January 24, 2004





Both Spirit and Opportunity have found evidence of ancient, wet, and habitable Martian environments, though on opposite sides of the Red Planet.

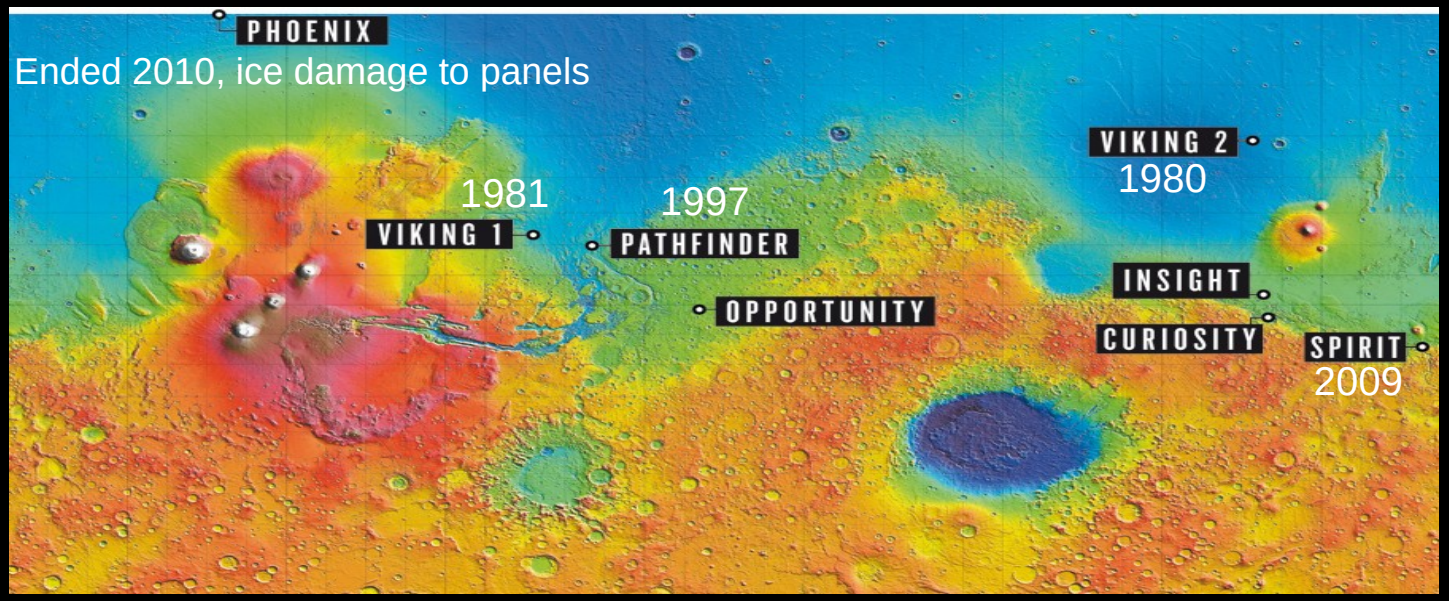
The rovers have sent > 100,000 high res, full-color images.

Spirit functioned until 2009 when it become stuck, but Opportunity continues to gather data.

Global Topography With Mars Landers and Rovers

Reds and pinks are higher elevation (3 km to 8 km)

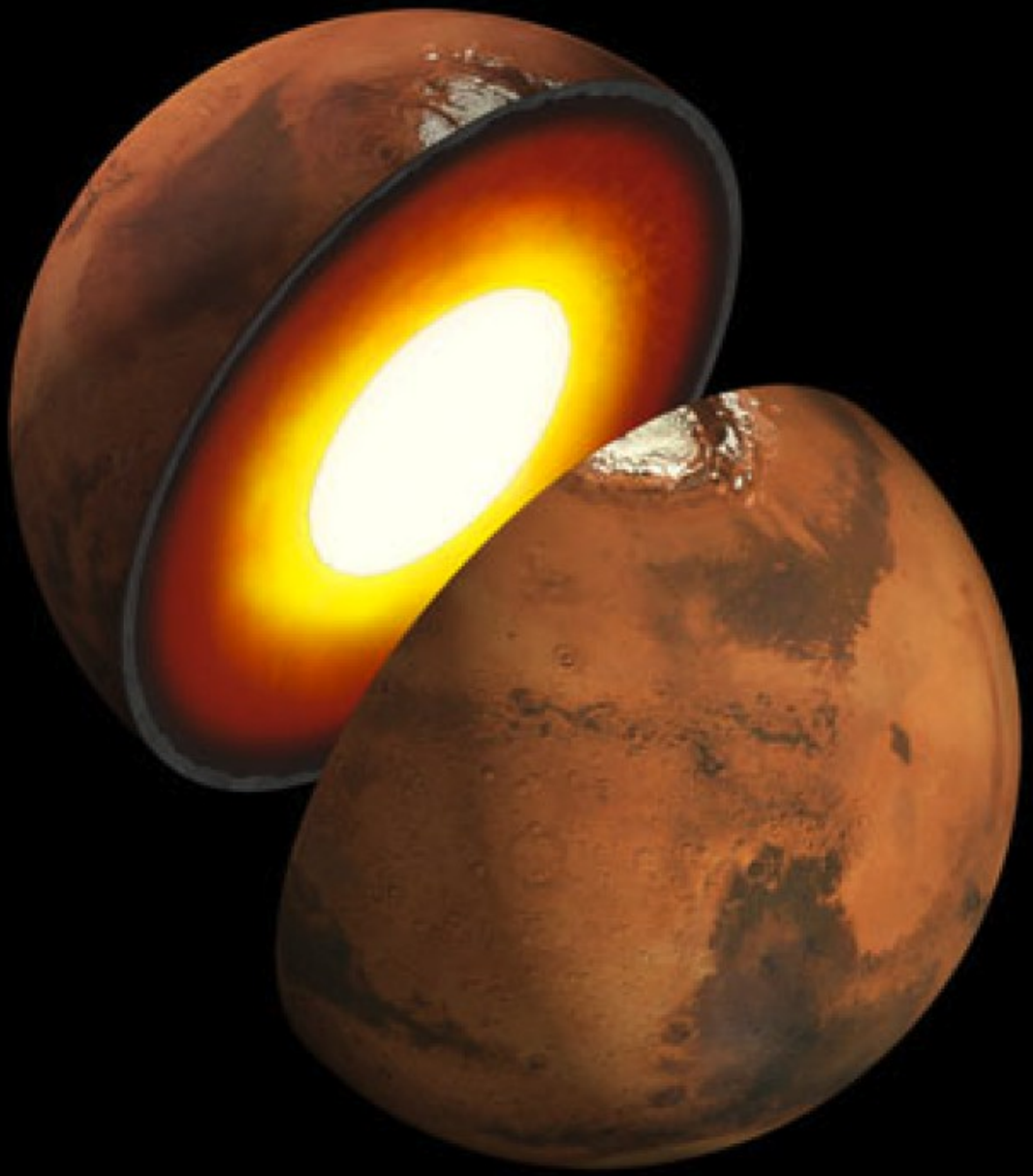
Whites and browns are highest elevation (greater than8 to 12 km)



The map was produced with the Mars Orbiter Laser Altimeter (MOLA), one instrument of the MGS.

Curiosity is functioning -- launched November 26, 2011, landed August 5, 2012

Science Goals

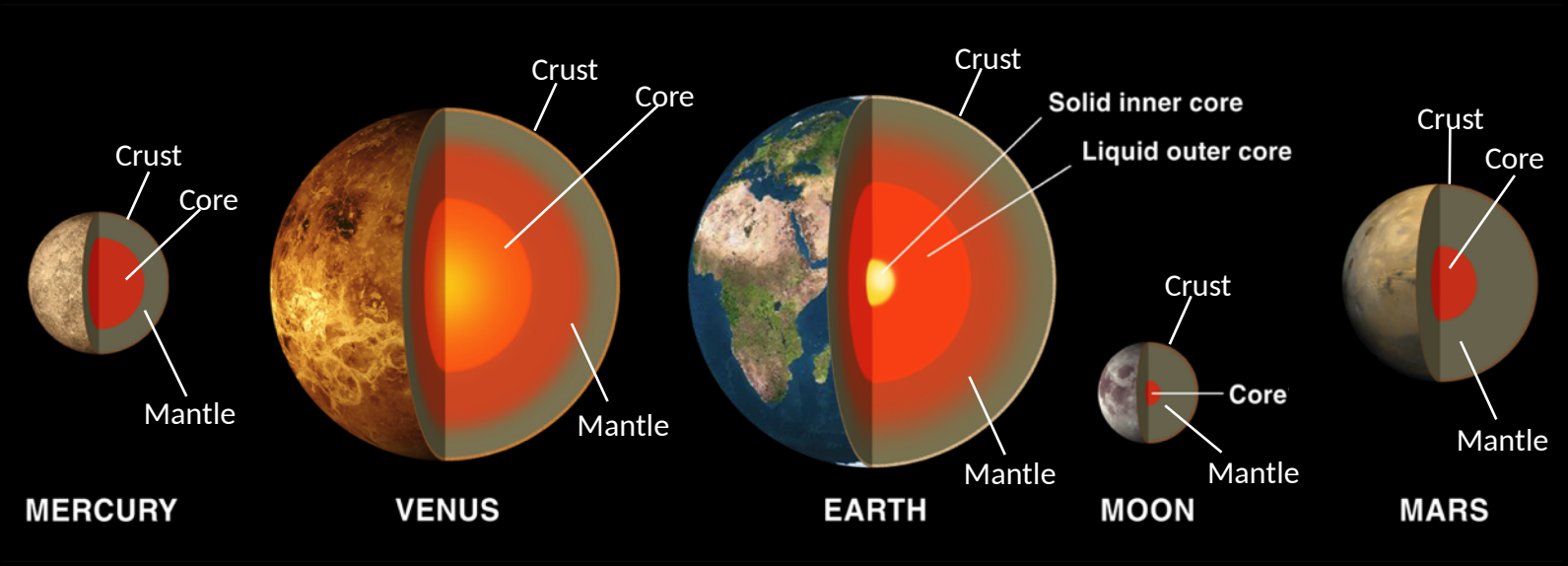


Understand the formation and evolution of terrestrial planets through investigation of the interior structure and processes of Mars.

- **Seismology**
- **Geodesy**
- **Heat Flow**
- **Magnetics**

Why Do We Care?

Terrestrial planets all share a common structural framework: crust, mantle, core.



Crust: Outermost layer of a rocky planet.

Mantle: Chemically different from the crust, the mantle results from heavier elements sinking, called differentiation.

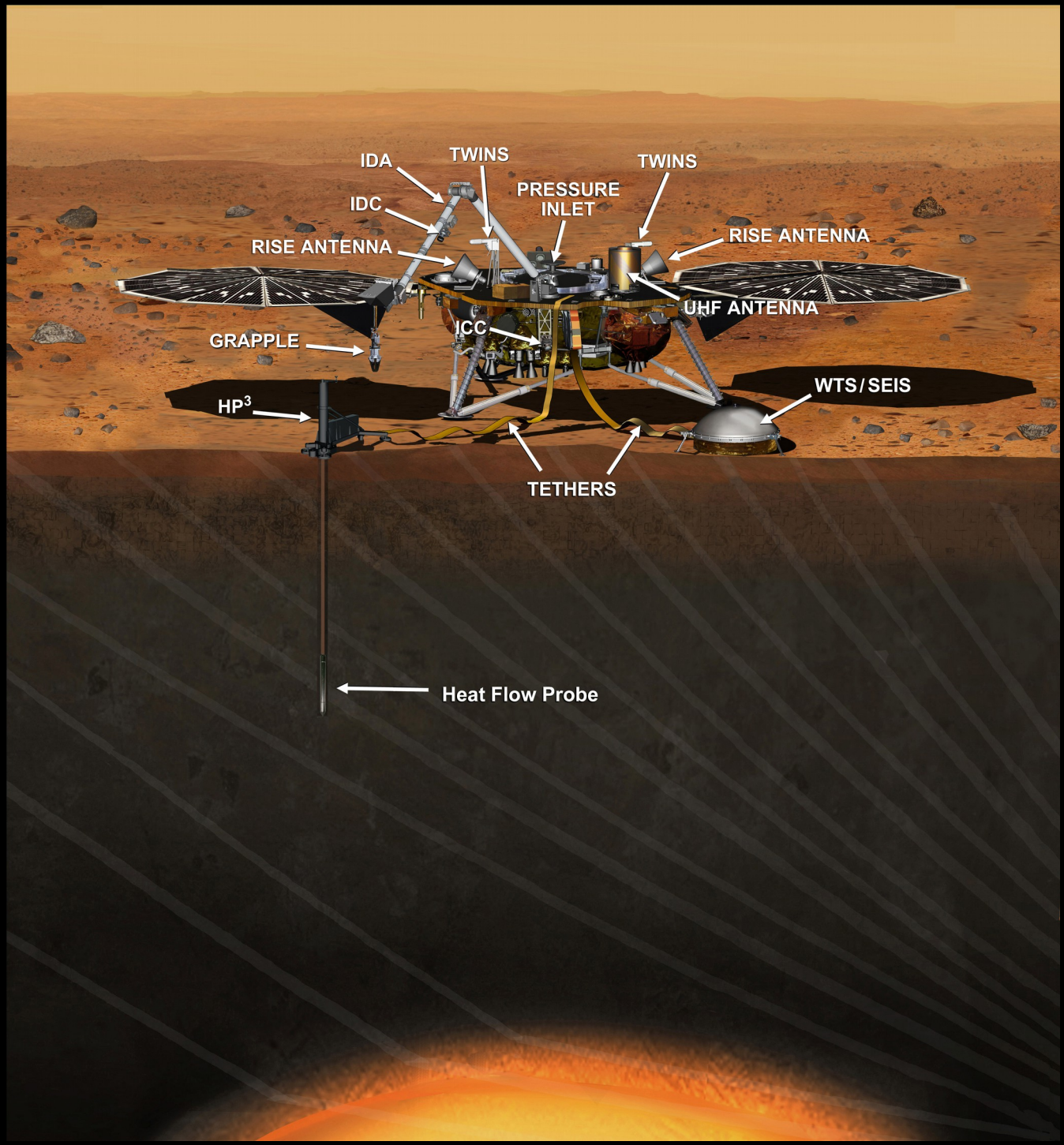
Core: Innermost layer of a terrestrial planet, it can be solid and liquid.

Soon -- More Mars Seismology

InSIGHT

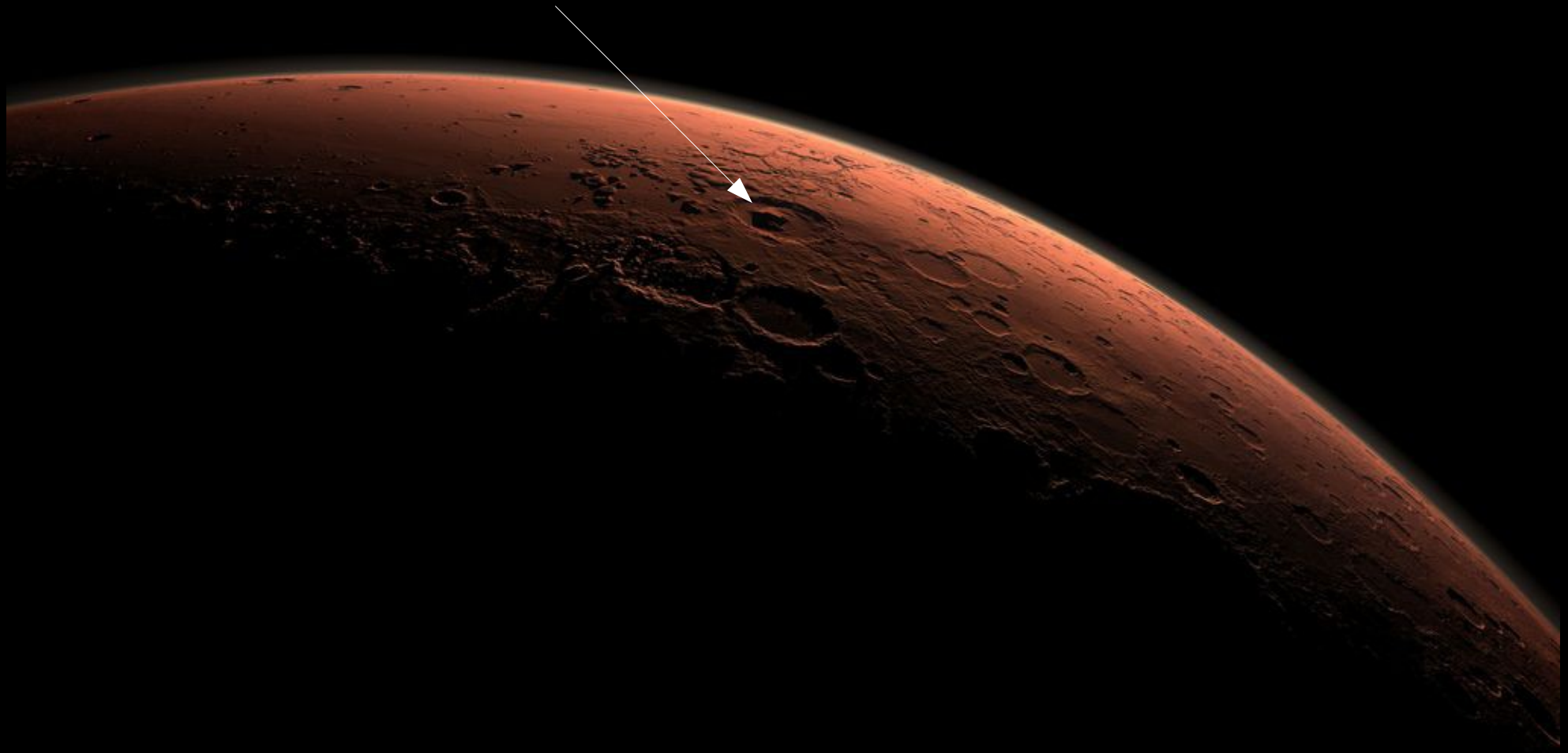
Interior Exploration using Seismic Investigations, Geodesy, and Heat Transport

Launch May 2018



Daybreak at Gale Crater

2020: Launch of a rover designed after the Mars Science Laboratory and its Curiosity rover



Summary

The journey to Mars is not easy, but is worthwhile to:

- determine if life ever arose on Mars,
- characterize the climate of Mars,
- characterize the geology of Mars,
- prepare for human exploration.

Knowledge and technologies developed during our journey will help life on Earth.

Would you like to go to Mars?

Acknowlegements: Dr. Renee Weber, InSPIRE Science Co-Investigator,
Ms. Jensen Smith, NASA summer Intern, 2016

The Great American Solar Eclipse

August 21, 2017

National Aeronautics and Space Administration

NASA

What is a Solar Eclipse?

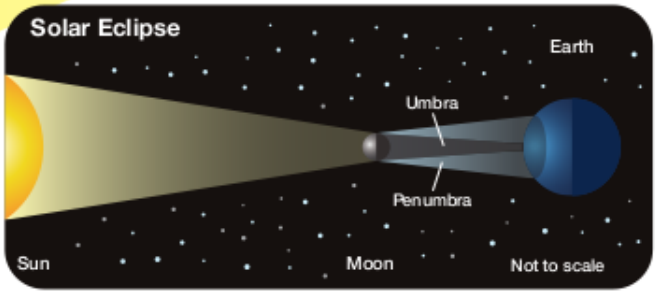
A **solar eclipse** happens when the Moon, as it orbits Earth, fully or partially blocks the light of the Sun, thus casting its shadow on Earth.

Observers within the path of totality can expect to see something like the image below. bservers outside the path of totality will see the Sun partially eclipsed as a crescent Sun (with safe filters).

Greatest Eclipse

Time	Location
10:17 a.m. PDT	Lincoln Beach, OR Depoe Bay, OR
11:26 a.m. MDT	Lime, ID
1:19 p.m. CDT	Valley View, MO Bloomsdale, MO
1:28 p.m. CDT	Calistia, TN
2:47 p.m. EDT	Bethera, SC

After the 2017 solar eclipse, the next **total solar eclipse** visible over the continental United States will be on **April 8, 2024**.



If the Sun is scaled to about 10 cm (3.9 in), Earth would be about 10 meters away (33 feet).

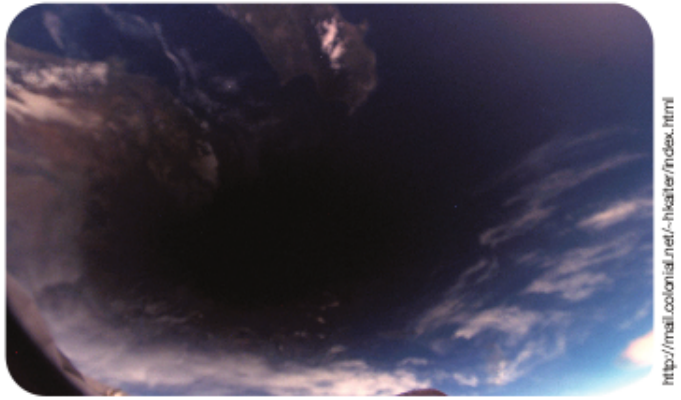
The predicted path of the August 21, 2017 solar eclipse

Duration of Greatest Eclipse:
2 min 40 sec
(18:25 UT=13:25 CDT or 1:25 p.m. CDT)

Location Greatest Eclipse:
36 deg 58 min N; 87 deg 40 min W
(between Princeton and Hopkinsville, KY)

Path Width: **approximately 115 km**

Eclipse Predictions by Fred Espenak, GSFC, NASA-emeritus



http://mail.colonial.net/~hkaiter/index.html

Never look directly at the Sun unless you have filters that you know are safe.

For more information: http://eclipse/gsfc.nasa.gov/SEhelp/safety.html
For more information about solar eclipses: http://eclipse.gsfc.nasa.gov/solar.html
http://eclipsewise.com/solar
http://eclipse2017.org/

www.nasa.gov

The NASA image above shows the Moon's umbral shadow as seen from the International Space Station during the total solar eclipse on 29 March 2006.

Mitzi Adams • *mitzi.adams@nasa.gov* • **256–961–7626**

FL–2016–06–52–MSFC G–157953